

**HEATING PAD HAVING A PHASE CHANGE MATERIAL****CROSS-REFERENCE TO RELATED APPLICATION**

This application claims priority of Chinese Patent Application No. 03266285.8 filed on June 27, 2003.

**5 BACKGROUND OF THE INVENTION****1. Field of the Invention**

This invention relates to a heating pad, more particularly to a heating pad having a phase change material.

**2. Description of the Related Art**

10 A therapeutic heating pad which is made of a phase change or thermal energy storage material typically includes an envelope 1 filled with a phase change material 10, as shown in Figure 1. The phase change material is in a solid or gel-like format normal or room temperature. When the heating pad is to be used, it is put into water and heated so that the phase change material absorbs heat and is transformed into liquid, thus storing thermal energy. At this time, the heating pad can supply heat for therapeutic purposes. When the phase change material becomes cold due to its 15 liberation of heat, the phase change material returns to its solid or gel state. While such a heating pad has a simple construction, because the heating pad must be heated in water, it is suitable only for the household use. The application thereof is therefore limited.

20 25 Figure 2 shows another conventional heating pad 1A which contains a liquid state phase change material 11 enclosing a metal plate 12. When it is used, a force is applied to

the metal plate 12 to deform the metal plate 12. The phase change material 11 which is in the liquid state begins to liberate heat and change into a gel-like form. This heating pad 1A is also simple in construction. However, when the 5 heating pad 1A is to be reused, it must be heated in water to cause the phase change material 11 to return to its liquid form from the gel-like form. Therefore, the application of the heating pad 1A is also limited. It is thus desirable to develop a heating pad with a self-heating means to heat 10 a phase change material contained therein.

#### **SUMMARY OF THE INVENTION**

An object of the present invention is to provide a heating pad with a self-heating unit so that a phase change material contained therein can be heated without using water and 15 external heat source.

According to the present invention, a heating pad comprises: an envelope confining a receiving space; a heating unit including a metal plate, and a resistance heating element attached to the metal plate; a positioning 20 unit mounted within the receiving space and connected to the metal plate; a phase change material provided within the receiving space and enclosing the heating unit; and a pair of electrodes connected to the heating element and extending outwardly of the envelope.

#### **25 BRIEF DESCRIPTION OF THE DRAWINGS**

Other features and advantages of the present invention will become apparent in the following detailed description

of the preferred embodiments of the invention, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic view of a conventional heating pad;

5 Fig. 2 is a schematic view of another conventional heating pad;

Fig. 3 is a perspective view of a heating pad embodying the present invention;

10 Fig. 4 is a plan view of a modified form of the heating pad of Fig. 3;

Fig. 5 is a plan view of another modified form of the heating pad of Fig. 3;

Fig. 6 is the same view as Fig. 4 but with a connector being added to the heating pad; and

15 Fig. 7 is the same view as Fig. 5 but with a connector being added to the heating pad.

#### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Before the present invention is described in greater detail, it should be noted that same reference numerals 20 have been used to denote like elements throughout the specification.

Referring to Fig. 3, a heating pad embodying the present invention is shown as being a therapeutic heating pad (A) which includes an envelope 2 that confines a receiving space 25 20. The envelope 2 is made of a material which is leakproof and which is durable and strong enough to prevent breakage. In this embodiment, the envelope 2 is made of a plastic

material such as polyethylene or an aluminum foil. A positioning unit 3 is disposed within the receiving space 20 to position a heating unit 4 inside the receiving space 20.

5 The heating unit 4 includes a metal plate 40 and a resistance heating element 41 attached to the metal plate 40. The resistance heating element 41 is insulated, and may be a resistance coil bonded to the metal plate 40, or a resistance wire printed on the metal plate 40. The 10 positioning unit 3 includes four flexible strips 31 attached respectively to four corners of the envelope 2 by, for example, a thermal bonding process, so that they are hung on the four corners of the envelope 2. The other ends of the strips 31 are connected respectively to four corners of the metal 15 plate 40. The strips 31 in this embodiment are made of the same material as the envelope 2, and each strip 31 is attached to the metal plate 40 by extending through one of the holes 401 formed in the metal plate 40.

The heating pad (A) further includes a thermal storage 20 material, such as a phase change material 5, which is received by the receiving space 20 of the envelope 2. The phase change material 5 encloses entirely the heating unit 4.

A pair of electrodes 42 are connected respectively to two ends of the resistance heating element 41 and have ends 25 420, 421 which extend out of the envelope 2. The ends 420, 421 may be connected to a power source, such as a battery assembly (not shown).

When the ends 420 and 421 of the electrodes 42 are connected electrically to a power source, the resistance heating element 41 of the heating unit 4 will generate heat which will be transferred to the metal plate 40, thereby heating 5 the phase change material 5. When the temperature of the heating pad (A) reaches a desired level, the heating element 41 can be disconnected from the power source. As the phase change material 5 is heated, it undergoes a phase change process and stores thermal energy which can be supplied 10 to a patient for therapy. When the heating pad (A) or the phase change material 5 becomes cold, the heating unit 4 may be connected to the power source once again to heat the phase change material 5. As the heating pad (A) of the present invention is provided with the heating unit 4 which 15 can be connected to a battery assembly to heat the phase change material 5, the heating pad (A) may be conveniently used either indoors or outdoors.

As shown in Figure 4, a thermal control switch 7 may be provided additionally in the heating pad (A) in series 20 connection with the heating element 41. The control switch 7 serves to control the temperature of the heating pad (A) so that, when the heating pad (A) reaches a predetermined temperature, the heating unit 4 is disconnected automatically from the power source. Generally, the 25 temperature which is practical for a therapeutic heating pad is about 35°C. If the phase change material (also known as a thermal storage material) 5 used in the heating pad

(A) is a material which is convertible from a solid state to a liquid state within a temperature range of about 29 °C - 30°C and which can be heated to a temperature up to 45°C in its liquid state, in order to keep the temperature of the heating pad (A) within a practical range or to prevent the temperature of the heating pad (A) from rising to 45 °C, the control switch 7 can act to control the electrical connection between the heating unit 4 and the power source so that the heating unit 4 is disconnected from the power source when the temperature of the phase change material 5 reaches a preset temperature. On the other hand, the control switch 7 may be arranged in such a manner that it re-connects the heating element 41 to the power source when the temperature of the heating pad (A) is lower than a preset temperature by 3°C. As such, the consumption of electrical energy can be minimized and the service life of the heating pad (A) can be prolonged.

Referring to Figure 5, the heating pad (A) may be further provided with a light emitting diode 8 adjacent to the electrodes 421 as an indicator for indicating an operative state of the heating pad (A).

The arrangements shown Figures 4 and 5 may be modified to incorporate a connector 9 as shown in Figures 6 and 7. The connector 9 may be a plug connector or a socket connector, and may be connected directly to the ends of the electrodes 420, 421. Through the connector 9, the heating pad (A) can be conveniently connected to the power source.

While the present invention has been described in connection with what is considered the most practical and preferred embodiments, it is understood that this invention is not limited to the disclosed embodiments but is intended to cover various arrangements included within the spirit and scope of the broadest interpretations and equivalent arrangements.